

“Development of Procurement Guidelines for Air-Cooled Condensers”

by

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Can You Spare A Dime?

(Check out those Suspenders!)



Project Objectives

- *Identify Key Design and Operating Issues Facing Owner/ Operators of Air-Cooled Condensers (ACCs),*
- *Develop and Present Improved Guidelines for the Specification of ACCs*

General Project Process

- *Assess operating and performance issues with ACC's;*
- *Develop information that should be included in and solicited via procurement specifications for ACC's;*
- *Provide example procedures for evaluation and comparisons of bids; and*
- *Develop and present guidelines for performance and acceptance testing of ACC's.*

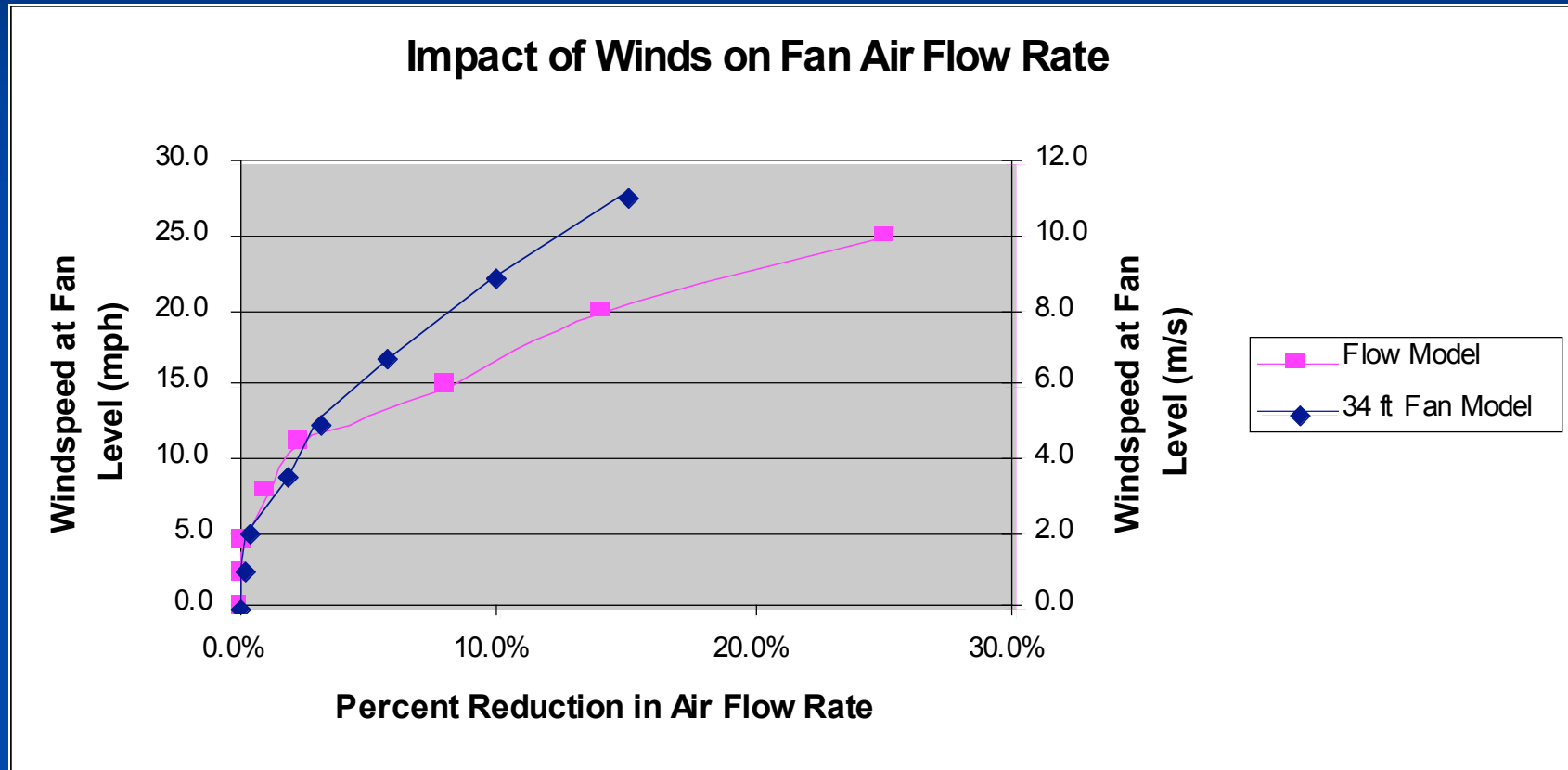
Key Areas Identified

- **Wind Effects** - *Prevailing Winds can significantly reduce the Performance of the ACC, leading to higher plant heat rates and, in some cases load curtailments and turbine trips.*
- **Range of Operating Conditions** - *An ACC must be able operate over a wide range of heat loads and ambient temperatures (e.g. 100°F).*
- **Fouling of ACC Coils** – *Wind-borne contaminants can foul finned-tube heat exchangers and reduce performance.*
- **Inlet Air Conditioning** – *Many sites have attempted inlet spray cooling with typically poor results, and in some cases resultant heat exchanger degradation.*

Wind Effects

- *flow separation at the fan inlet, poor fan performance, and reduced system airflow;*
- *recirculation of the hot exit air into the air inlet of the ACC; and*
- *mal-distribution of the air in the plenum area and across the heat exchange surfaces.*

Potential Impact of Winds on Fan Performance and Air Flow Rate



Use of An Extended Wing to Reduce Recirculation of Heated Exhaust Plume



Use of A Wind Screen to Reduce Wind Effects and “Filter” Ambient Dusts



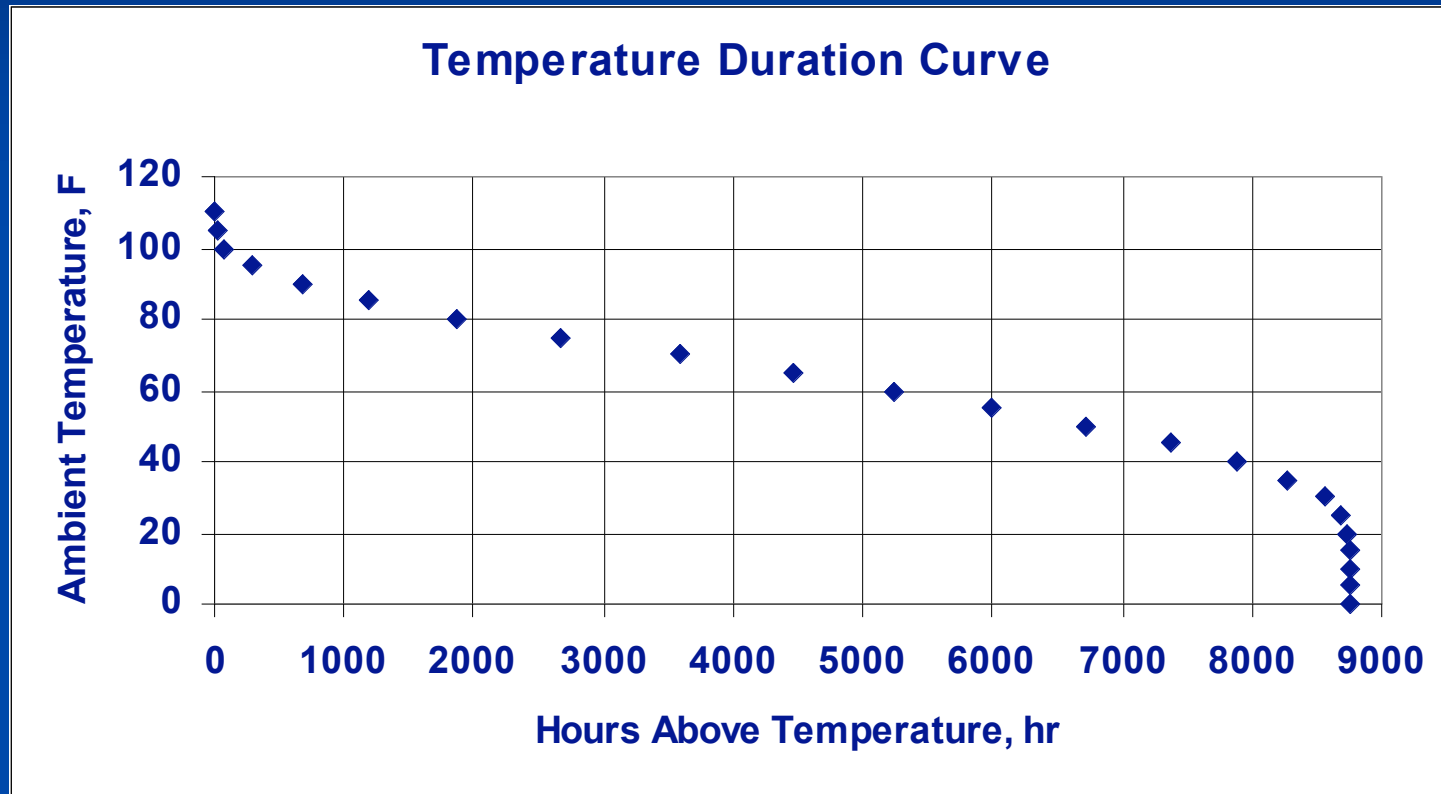
ACC Design Point Specification

Basic Parameters

Example 500 MWe Combined-Cycle Plant

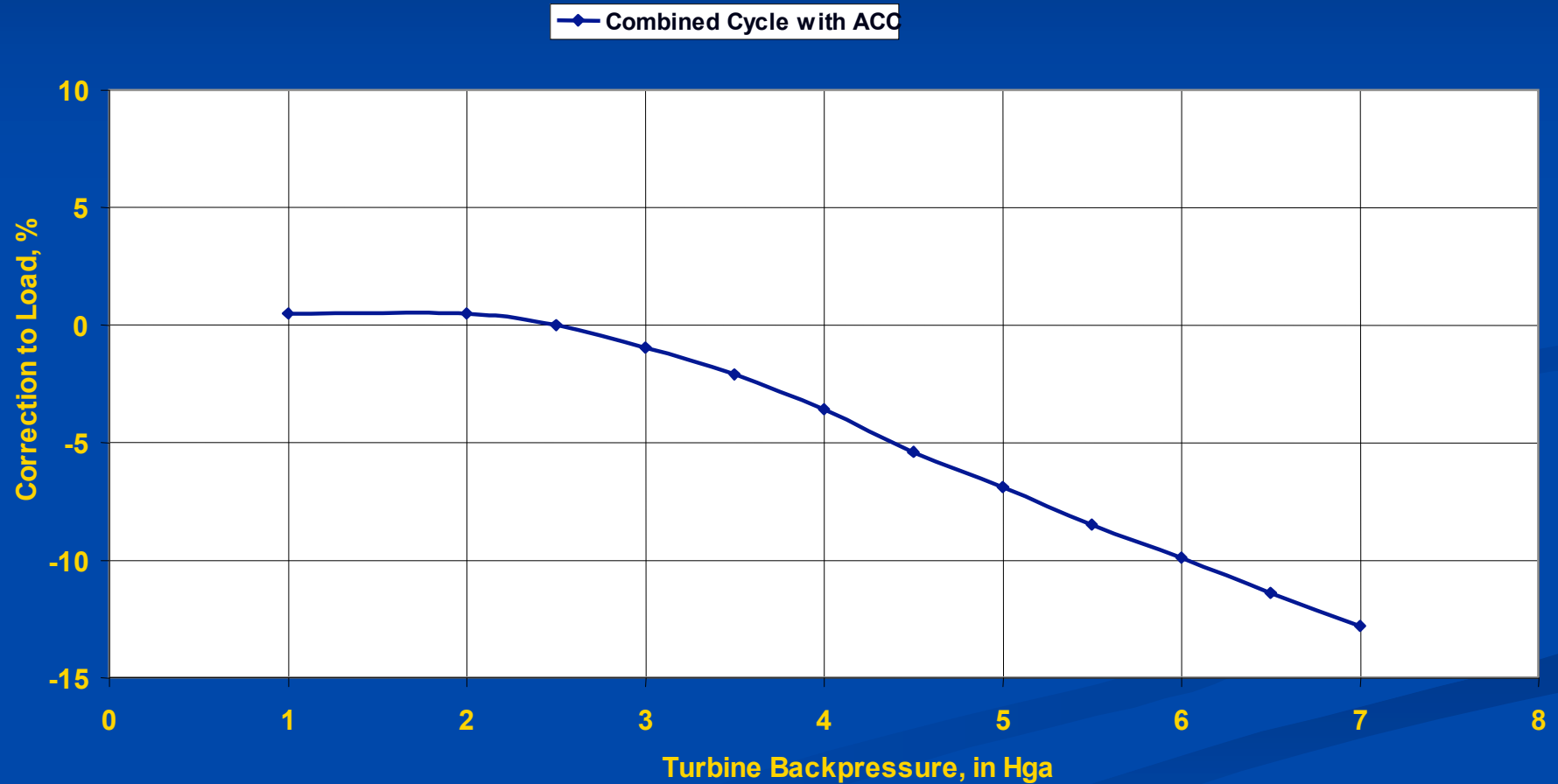
- *Steam flow, W (lb/hr):* 1.1×10^6
- *Quality, x (lb/lb)* 0.95
- *Backpressure, p_b (in Hga)* 4.0
- *Ambient temperature, T_{amb} (°F)* 80
- *Site elevation Sea level ($p_{amb} = 29.92$ in Hga)*

Example Temperature “Duration” Curve U.S. Desert Southwest



Load Correction as a Function of Turbine Exhaust Pressure

Load Correction vs. Backpressure



ACC Performance Test Code Development

- *Both the American Society of Mechanical Engineers and the Cooling Technology Institute are in the process of developing Performance Test Codes for ACC's -see Note (a)*
- *This (EPRI) Procurement Guideline includes “flags” relative to wind effects and a Performance Test Procedure including an improved methodology for Steam Quality Determination*

Note (a) CAVEAT EMPTOR -actual operating performance of ACC's may be substantially lower than that determined by a test conducted under the wind limitations currently contemplated by these Codes.

Estimation of Steam Quality at the Turbine Exhaust

- *Uses Used Energy End Point (UEEP) Versus Expansion Line End Point (ELEP)*
- *Slope of the enthalpy versus entropy line for the low pressure steam turbine is independent of the exhaust pressure, inlet temperature, pressure and flow.*
- *Equivalent to assuming a constant isentropic efficiency for the low pressure turbine.*
- *Studies using cycle models have indicated that the error involved with calculating the steam quality based on this assumption is less than 1 percent.*

Conclusions

The application and popularity of Air-Cooled Condensers (ACC) is increasing in the United States. There are important factors which affect the design, performance, testing and operation of an ACC. Clearly, development of appropriate design information, sensitivity to the impacts of prevailing winds, and guidelines for performance and acceptance testing are key areas of focus.

References

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